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PLEISTOCENE MAMMALS OF FOSSIL LAKE, OREGON

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The fauna of the Fossil Lake region of south-central Oregon has long been known as one of the largest faunas of the plains type in the Pleistocene of the West. Its importance is enhanced by the presence, in addition to numerous mammals, of over fifty species of birds and many species of fish. The birds have been described by E. D. Cope, R. W. Shufeldt and L. H. Miller, and the fish by E. D. Cope and D. S. Jordan. With the exception of the camels and the ground-sloth, described by Cope, and the muskrat, described by Hollister, the mammals have been referred to merely in faunal lists. The present paper is the result of study of the Fossil Lake material in the Museum of Palæontology of the University of California and in the American Museum of Natural History. Acknowledgment is gratefully made to Professor Chester Stock, under whose supervision the study was begun, and to the late Professor W. D. Matthew, Professor Joseph Grinnell and Mr. E. L. Furlong for generous assistance and advice.

LOCATION OF FOSSIL LAKE BEDS

Fossil Lake is situated in south-central Oregon in longitude 120° 30′ West and latitude of 43° 20′ North. To the southwest, and separated from it by a very slight elevation, are Christmas Lake, at a distance of five miles, and Silver Lake at twenty-five miles. In the literature some confusion exists as to the name of the fossil beds, Fossil Lake, Christmas Lake and Silver Lake being used; Fossil Lake seems to be the most appropriate term. The water level in the lakes is continually fluctuating so that frequently the lakes become entirely dry, as in the case of Fossil Lake in recent years. During Pleistocene time, according to Russell (1884), the water reached a depth of over one hundred feet, so that the three lakes were joined into one large body of water which remained without an outlet. During this expansion of the lake, extensive deposits of sand and clay were formed on the bottom. These deposits have preserved for us the remains of some of the mammals which lived on the borders of the lake at that time, as well as those of fish and birds. The

bones have been exposed by the desiccation of the lake and have been intermittently covered by the drifting sand which at present obscures a large part of the ancient lake bottom.

REVIEW OF PREVIOUS INVESTIGATIONS

Although the presence of bones at Fossil Lake had been apparent to the cattlemen of the region for some time, they were first brought to the attention of men with scientific training by Governor Whiteaker, who had noticed them while on a campaigning tour of southeastern Oregon in 1876. He called the attention of Professor Thomas Condon to them, with the result that in 1877 Condon visited Fossil Lake under the guidance of Governor Whiteaker's son. Later in the same year, extensive collecting was done by Charles H. Sternberg, the specimens being sent to Professor E. D. Cope. Two years later, in 1879, Cope visited the locality in person. Apparently no further collections were made at Fossil Lake until Miss Annie M. Alexander visited the region in 1901; the specimens procured at that time are now in the Museum of Palæontology of the University of California. To those specimens have been added further collections made by Chester Stock and E. L. Furlong in the summers of 1923 and 1924.

The early explorations resulted in a number of short articles from the pen of Professor Cope, describing the situation of the deposit and publishing his identifications of the forms discovered. No detailed descriptions of the mammals were published, with the exception of *Auchenia vitakeriana* (1878*a*), *Mylodon sodalis* (1878*a*), *Eschatius conidens* (1884*b*) and *Eschatius longirostris* (1884*b*). Cope described some species of birds (1878*a*) and of fishes (1878*a*, 1878*c*, 1883*b*). Much attention was paid at the time to the association of Indian arrow heads with the fossils, although it was recognized that this association might well be fortuitous. Cope's latest revision of the fauna is found in an article in the *American Naturalist* (1889*b*). In 1902, Dr. W. D. Matthew revised the mammals in Cope's collection.

In 1892, Shufeldt (1891, 1892) published his first detailed description of the avifauna, based on Cope's collection and the collection of Professor Condon. D. S. Jordan (1907) described some of the fossil fish. In 1911, L. H. Miller added some new names to the list of fossil birds, and it was further increased by a second study on the part of Shufeldt (1913). In the plates accompanying his paper, Shufeldt illustrated some mammalian material which had been inadvertently included in the avian material sent to him for examination. The mammalian remains were identified by J. W. Gidley.

AGE OF THE FOSSIL LAKE FAUNA

The age of the Fossil Lake deposit has been discussed at length by several authors, but this discussion has resulted in no definite conclusion. Cope (1889*a*) believed that the palæontologic evidence confirmed its age as Upper Pliocene, as suggested by Clarence King. As the result of a reconnaissance of the region, Russell (1884) recognized the similarity of the geologic phenomena indicated at Fossil Lake to those of Lake Lahontan. This apparent disagreement with the Upper Pliocene age advocated by Cope was thoroughly discussed by G. K. Gilbert (1890). Gilbert came to the conclusion that on geologic evidence the Fossil Lake beds belong to the epoch of the Upper Lahontan beds or Later Pleistocene, but that the palæontologic evidence indicated a closer affinity with the Upper Pliocene or Lower Pleistocene. W. D. Matthew (1902) recognized the similarity of the fauna to that found at Hay Springs, Nebraska. In 1904, W. J. Sinclair concluded that it was probably of about the same age as the fauna of the Potter Creek Cave. Osborn (1909) referred the fauna to the "Subsequent Phases of the Middle Pleistocene," but in 1910 he placed it in the "Early phases of the Equus Zone" or early Pleistocene. O. P. Hay (1912, 1923, 1927) agreed with the determination of the age as early Pleistocene, considering it as belonging to the Aftonian interglacial stage. In 1918, J. C. Merriam gave a comprehensive review of the problem in connection with the age of a fauna found in the deposits of Lake Lahontan, concluding that, since approximately two-thirds of the mammals belong to extinct species, the age of the fauna must be quite far removed from the present. Miller (1925) concluded that Fossil Lake is of greater age than either McKittrick or Rancho La Brea, having 37% of extinct species of birds, compared with 27% for Rancho La Brea and 20% for McKittrick.

The present study has confirmed the early Pleistocene age of the Fossil Lake deposits. The mammalian fauna is found to embrace 17 genera including 23 species, of which 8 genera, or 47%, and 15 species, or 65%, are now extinct. In arriving at the figures for the species, there was some room for error on account of the fragmentary nature of the material, but it is not believed that the deviation is very great. This would place the age of the Fossil Lake fauna close to that of Rancho La Brea, with 67% of extinct mammalian species, Hawver Cave with from 50–75%, McKittrick with almost all extinct, Hay Springs with 67% and Port Kennedy with 74%, the figures being computed from data in

Hay.[1] It is the belief of Hay that all these faunas belong to some portion of the Aftonian interglacial stage.

When it comes to a closer comparison of the relative age of the western Pleistocene deposits, more uncertainty is encountered. Comparing Fossil Lake with Rancho La Brea, the most noticeable differences are the absence in the Fossil Lake fauna of *Bison, Mastodon, Megalonyx, Smilodon* and *Capromeryx*. But negative evidence is of dubious value with as scanty material as that of Fossil Lake; until the present study was undertaken, the absence of *Arctotherium, Canis dirus* and felids of any description was urged as evidence of a difference in age between Fossil Lake and Rancho La Brea. The most accurate estimate of the age of the Fossil Lake fauna which we are justified in making on the basis of the mammalian remains is early Pleistocene, approximating that of Rancho La Brea.

MAMMALIAN FAUNA

The fossils collected from the Fossil Lake beds are now distributed in three places. The largest collection, made by Sternberg and Cope, is the property of The American Museum of Natural History. The specimens collected by Condon are in the possession of the University of Oregon. The remainder of the known specimens from Fossil Lake are in the Museum of Palæontology of the University of California. They were collected in part by Miss Alexander in 1901 and in part by Stock and Furlong in the summers of 1923 and 1924.

The present paper is based on the material in the University of California and American Museum collections. It was not possible to study the collections at the University of Oregon. A complete list of the material there has never been published, but partial lists prepared by Ellen Condon McCornack (1914 and 1920) contain no mention of forms not represented in the collections studied.

In the following list of the mammalian fauna of Fossil Lake, † indicates that the species is extinct and †† that the genus also did not survive the Pleistocene in North America.

CARNIVORA

†*Canis* cf. *dirus*
Canis cf. *occidentalis*
Canis lestes.
Vulpes sp.

[1]Hay, O. P. 'Pleistocene of North America.' Carnegie Institution of Washington, Publs. 322, 322A, 322B. 1923, 1924, 1927.

?†*Felis* sp. major
Felis sp. minor
††*Arctotherium* sp.
?††*Taxidea*, probably n. sp.
RODENTIA
†*Castor*, probably n. sp.
†*Fiber oregonus*
Microtus montanus
Thomomys townsendi
LAGOMORPHA
Lepus sp.
EDENTATA
††*Mylodon*, near *harlani*
PROBOSCIDEA
††*Elephas ?columbi*
PERISSODACTYLA
††*Equus pacificus*
††*Equus* sp. minor.
ARTIODACTYLA
Antilocapra cf. *americana*
††*Platygonus* cf. *vetus*
††*Platygonus* sp. minor
††*Camelops hesternus*
†††*Tanupolama* sp.
††*Eschatius* sp.

DESCRIPTION OF MATERIAL

CARNIVORA

Canidæ

Canis cf. dirus

The presence of the dire-wolf in the Fossil Lake beds is apparently indicated by a fragmentary lower carnassial of the right side, U. C. 26910. Only the heel and portions of the protoconid and metaconid are preserved. The features which distinguish this tooth from the lower carnassials of the timber-wolves and which suggest affinity with *C. dirus* are its size and the character of the heel. The greatest width of the heel is 13.4 mm., almost equaling that of larger individuals of *C. dirus* from Rancho La Brea. Of eleven specimens of wolves of various species in the collections of the California Museum of Vertebrate Zoology, the largest M_1, that of *C. occidentalis*, has a heel measuring 11.4 mm. in greatest width. Merriam[1] gives the greatest transverse diameter of the heel of M_1 of a specimen of *C. occidentalis* from Canada as 12.2 mm.

[1]Merriam, J. C. 1912. 'The Fauna of Rancho La Brea.' Univ. Calif. Mem., I, No. 2, p. 232.

The heel of the tooth from Fossil Lake is therefore at least one millimeter wider than that of the large timber-wolves now living in North America.

The heel is characterized by a well developed hypoconid and a smaller entoconid, the latter cusp being joined to the hypoconid by a sharp ridge. Another ridge joins the hypoconid and protoconid. A third ridge, connecting the entoconid and metaconid, bears three small tubercles, similar in appearance and position to those found in M_1 of

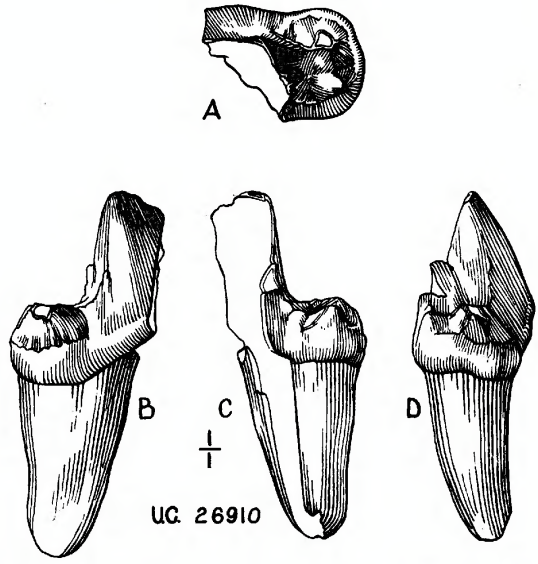

Fig. 1. *Canis* cf. *dirus*. Right lower M_1. Univ. Calif. 26910.
A, Crown view. B, external view. C, internal view. D, Posterior view. Natural size.

C. dirus. Tubercles resembling these are sometimes found in modern timber-wolves but they are never as well developed. The three ridges enclose a basin of pronounced depth. This basin is never so well developed in the modern wolves as in those of the *C. dirus* group, due to the less perfect development of the connecting ridges in the modern forms.

The hypoconid of the Fossil Lake tooth differs from that in the typical representatives of *C. dirus* and *C. milleri* in occupying a median position on the heel instead of being nearer the buccal border. The importance of this character is doubtful in view of the great variation which it undergoes.

The limb elements referred to *C. dirus* include the distal two-thirds of a humerus and right metacarpals 3 and 5. These agree with the corresponding elements of *C. dirus* in length but are slightly more slender.

Canis cf. **occidentalis**

Occurring in conjunction with the remains of *Canis* cf. *dirus* are those of another large wolf. This form resembles *C. occidentalis*, but, since it is known only by a radius, humerus, navicular and calcaneum and a few other fragments, precise identification is impossible. This form approaches *C. occidentalis* quite closely in size, the elements being about one-twentieth longer and slightly heavier. In view of this close similarity, it seems advisable to refer this form provisionally to *C. occidentalis*, recognizing the possibility that future collections may show that it grades into the larger form, *C.* cf. *dirus*.

Canis lestes

The most abundant canid remains are those of the coyote, consisting of five fragmentary mandibles and nine metapodials. The mandible differs from that of *C. latrans* in having a more vertical coronoid process and from both *C. latrans* and *C. estor* in having a more convex inferior border. In both these characters it resembles *C. lestes*.

Vulpes sp.

A femur and a tibia, both of the right side, are the only known remains of the foxes of Fossil Lake. In general proportions the two bones resemble *Vulpes* more closely than they do *Urocyon* and are therefore referred to *Vulpes*.

Felidæ

Felis sp. major

Of the two types of cats found at Fossil Lake, the larger is represented by portions of an ulna, a radius and a tibia, a scapholunar, a metacarpal, a metatarsal and a thoracic vertebra. In size the elements are intermediate between the puma, *Felis oregonensis californica*, and the fossil lion, *Felis atrox*. The scapholunar apparently belonged to a larger individual than did the other bones. Due to the fragmentary condition of the material, it is impossible to conclude whether this large feline of Fossil Lake constitutes a new species or should be referred to *Felis atrox*.

Felis sp. minor

The smaller member of the Felidæ is known by very fragmentary remains of a humerus, ulna, radius and three metapodials. In size it is intermediate between the ocelot, *Felis pardalis*, and the cougar, *Felis concolor*.

Ursidæ

Arctotherium sp.

The Ursidæ are represented by three bones: an ectocuneiform, a worn metapodial and a proximal phalanx. The ectocuneiform was compared with corresponding bones of *Arctotherium simum* from Potter Creek Cave, an arctothere from the Rock Creek Pleistocene, *Euarctos*

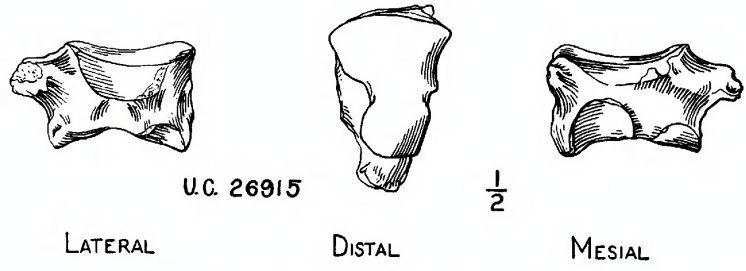

Fig. 2. *Arctotherium* sp. Right cuneiform, Univ. Calif. 26915. One-half natural size.

americanus, and two large Alaskan bears, *Ursus gyas* and *Ursus alexandræ*. The Fossil Lake specimen, U. C. 26915, bears a very close resemblance to U. C. 8343 from Potter Creek Cave, differing from it in being slightly larger and in having the anterior facet for metatarsal II slightly concave instead of convex. It agrees in shape with the Rock Creek specimen, A. M. N. H. 12392, but exceeds it in size. The ectocuneiform of the black bear, *Euarctos americanus*, is remarkably close in shape to that of *Arctotherium simum*, but in even the largest individuals of *Euarctos*, as well as of *Ursus*, the ectocuneiform is persistently of a much smaller size than in the Fossil Lake or Potter Creek Cave specimens.

Mustelidæ

Taxidea, probably n. sp.

The presence of the badger in the Fossil Lake fauna has not been previously reported. It is represented by a right maxilla containing a well-worn M^1 and by fragmentary limb bones. The maxillary bone

conforms in size to *Taxidea americana* but differs in that M^1 is wider, being 13.8 mm. wide in the fossil and having a maximum of 11.4 in the specimens of *T. americana* studied. The limb bones are fragmentary but indicate an animal about one-sixth larger than the modern species.

The inclusion of *Lutra* in Matthew's faunal list was due to an erroneous identification of the maxillary bone shown by the present study to belong to a badger. There is no evidence of the presence of *Lutra* in the Fossil Lake beds.

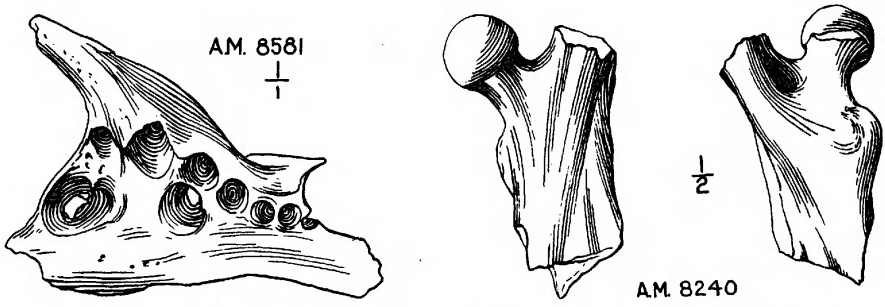

Fig. 3. *Taxidea*, probably n. sp. Right maxilla. Amer. Mus. 8581. Natural size.
Fig. 4. *Castor*, probably n. sp. Left femur. Amer. Mus. 8240. One-half natural size.

RODENTIA

Castoridæ

Castor, probably n. sp.

Three elements, a tooth, parts of an ilium and the proximal portion of a femur, belong to the genus *Castor*. The tooth is a M^1 or M^2 of the right side and cannot be distinguished from similar teeth of *C. canadensis*. The ilium is likewise indistinguishable from the same bone of the larger beavers of to-day. The femur differs from that of *C. canadensis* in being slightly larger and heavier and in that the notch between the head of the femur and the great trochanter is deeper. Although the shape of the notch varies greatly in the modern beaver, no specimen was observed which approximated the condition in the fossil. It may be that more complete material would warrant the creation of a new species to embrace the Fossil Lake beaver, but the present material is inadequate.

Cricetidæ

Fiber oregonus Hollister

Fiber oregonus was described and figured by Hollister (1911) from Fossil Lake, the type and only known specimen being the right mandibular ramus of a young adult, A. M. N. H. 8594. Hollister states that the mandible is almost identical with the corresponding bone of the living species except that it is much smaller; the "anterior loop of M_1 with deeper reentrant angles than in any living species; triangles not completely closed in any case."

Muridæ

Microtus montanus (Peale)

The meadow mouse is represented in the American Museum collections by the major portion of the horizontal ramus of a right mandible, including M_1 and M_2. *Microtus* sp. has also been reported by Miss McCornack in the University of Oregon collection.

Geomyidæ.

Thomomys townsendi (Bachman)

The *Thomomys* remains from Fossil Lake have been referred to in the literature as follows:

Thomomys near *clusius.*	Cope, 1878*a*, 1879, 1884*a*, 1889*a*, 1889*b*.
Thomomys talpoides.	Cope, 1878*a*, 1879, 1884*a*.
Thomomys bulbivorus.	Cope, 1883*a*, 1889*a*, 1889*b*.
Thomomys sp.	Matthew, 1902.
Thomomys scudderi, n.sp.	Hay, 1921.

As this list testifies, considerable confusion has prevailed as to the specific determination of the pocket gopher from Fossil Lake, this confusion reaching its climax in the creation of the new species *T. scudderi* by Hay in 1921, the type specimen being A. M. N. H. 8596. A detailed study of the skulls in the University of California collection, which had not been previously compared, supplemented by the material in the American Museum, has resulted in the inclusion of the fossil form in the still existent species *T. townsendi* (Bachman). Of this species, Bailey[1] recognizes two living subspecies: *T. townsendi townsendi*, now inhabiting the southern portion of Idaho, and *T. townsendi nevadensis*, found at present in north-central Nevada and the southeastern corner of Oregon.

[1]Bailey, Vernon. 1915. 'Revision of the Pocket Gophers of the Genus *Thomomys*.' North American Fauna No. 39.

The form found in the Fossil Lake beds does not seem to be subspecifically identical with either *T. t. townsendi* or *T. t. nevadensis*. The cheek tooth series is somewhat shorter and the individual teeth are slightly narrower than in *townsendi* or *nevadensis*. The posterior margin of the premaxilla is sharply pointed, in this respect resembling *townsendi;* a few of the specimens of *nevadensis* which were examined have tapering premaxillæ, but they are rounded at the extreme posterior tip. This character is subject to some variation. In the Fossil Lake specimens, the premaxillæ bear an outwardly projecting horizontal shelf which is very similar to that in *nevadensis*. In the single specimens of *townsendi* available for examination, a female, this shelf is not well developed. Examination of a series of *nevadensis* specimens indicates that this character is variable, the shelf not being so well developed in the female. The importance of this character, therefore, can not be judged before examining a larger series of skulls of *townsendi*. A fragment of the posterior portion of the skull, including the interparietal, has two temporal ridges, similar to the condition in both living subspecies.

The fossil form differs from *T. bulbivorus* in the following characters: smaller size; frontal process of premaxilla more sharply pointed and maxillary process of frontal more obtuse; lateral suture of maxilla with frontal straight or slightly convex instead of straight or slightly concave; temporal ridges not so well developed as the sagittal crest of *bulbivorus*.

From *T. talpoides clusius* the fossil specimens are separable on the basis of: larger size; more sharply pointed premaxillæ; less curvature of upper incisors; deeper rostrum; greater ventral extension of the zygomatic process of the maxilla; greater height of the depression in front of the infraorbital foramen.

The pocket gopher now living in the region of Fossil Lake is *T. quadratus quadratus*. The fossil form differs from *T. q. quadratus* in: larger size; nasals pointed posteriorly instead of truncate; premaxillæ extending farther posteriorly with reference to the nasals and being sharply pointed instead of rounded or truncate at their posterior termination; rostrum relatively wider; depression in front of infraorbital foramen has a longer dorso-ventral extension.

LAGOMORPHA

Leporidæ

Lepus sp.

That jackrabbits were relatively abundant at Fossil Lake seems a reasonable inference from the number of skeletal fragments found. The remains, however, are confined largely to the calcaneum, portions

of the pelvis and limb bones. From these it is impossible to tell whether the fossil form was closely related to *L. townsendi* (formerly *L. campestris*), to which it has been referred, or to *L. californicus*, also found in eastern Oregon today, or whether it might not be a separate species.

EDENTATA

Mylodontidæ

Mylodon near **harlani** Owen

The ground sloth was described as a new species, *Mylodon sodalis*, by Cope (1878*a*, p. 385) from a collection containing "a number of phalanges, including those of the ungues." The new species was based on an ungual phalanx (Cope, 1889*c*, p. 661, Fig. 1) which had the basal sheath developed only on one side and which was more compressed than in *Mylodon harlani*. Later work, as summarized by Stock (1925, p. 195), has shown that the apparent lack of a basal sheath on one side of the phalanx is due to breakage and that there is not sufficient reason for excluding this form from the species *harlani*. On the basis of some material collected by I. C. Russell near Button Ranch in1882, now in the United States National Museum, and a few bones from Fossil Lake, now in the University of California collections, Stock concluded that the mylodont sloths of south-central Oregon are not specifically different from those of Rancho La Brea but that further study might lead to their subspecific distinction; he suggested that the name *sodalis* might be retained as the subspecific designation.

Further study of the foot elements shows that they agree in general with those of *Mylodon harlani* from Rancho La Brea except that they are invariably of a slightly larger size. Some differences have been noted between the Fossil Lake form and that from Rancho La Brea, but their significance cannot be evaluated with the limited material at hand.

PROBOSCIDEA

Elephantidæ

Elephas ?**columbi**

The proboscidean remains from Fossil Lake include fragmentary limb and vertebral material and teeth. These were originally determined as *Elephas primigenius* by Cope, but Matthew (1902) referred them questionably to *Elephas columbi*. There is in addition a fragmentary lower right molar, A. M. N. H. 8629, of which only the six last plates are preserved. It has been referred to *Elephas imperator*, but there seems to be no valid reason why it could not belong to the same species as the other remains.

PERISSODACTYLA

Equidæ

Equus pacificus

Equus sp. minor

The horses of Fossil Lake have been studied by Stock and Furlong; the detailed results of their work will appear elsewhere. They concluded[1] that two types of horses are present, *Equus pacificus* and a new species of relatively small size.

ARTIODACTYLA

Antilocapridæ

Antilocapra cf. americana

The antelope remains, consisting of three astragali, the distal end of a humerus, proximal portion of an ulna, the acetabular region of a pelvis, and one tooth, either I_3 or C_1, are indistinguishable from the corresponding skeletal elements of *Antilocapra americana*.

Tagassuidæ

Platygonus cf. vetus

Platygonus sp. minor

Matthew (1902) reported some peccary teeth in the American Museum collection. He recognized two species, *Platygonus* cf. *vetus* and *Platygonus* sp. minor. Unfortunately this material was not available for the present study, so it is impossible to confirm the identification.

Camelidæ

Camelops hesternus Leidy

The largest camel present at Fossil Lake is represented by a fragment of the left maxillary containing part of M^1, a portion of the right mandible from the symphysis through M_1, and a number of limb bones and vertebræ. These agree in their diagnostic features and size with the corresponding elements in *Camelops hesternus* from Rancho La Brea. In the study of the limb elements it was not always possible to differentiate with certainty between those belonging to *C. hesternus* and those of *Eschatius conidens*, although the latter is somewhat smaller, approaching the size of the dromedary.

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[1]Oral communication from Professor Stock.

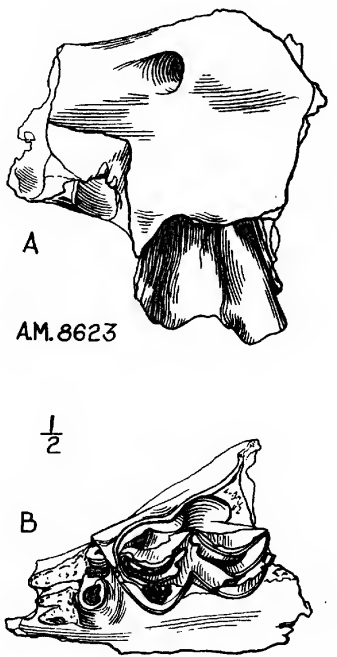

Fig. 5.

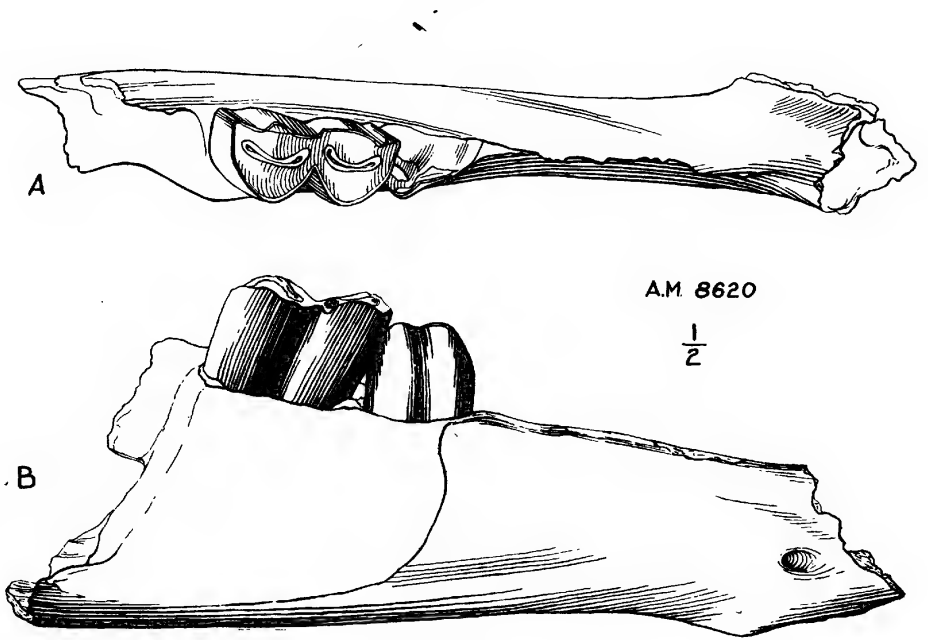

Fig. 6.

Fig. 5. *Camelops hesternus.* Part of left maxilla. Amer. Mus. 8623. A, lateral view. B, crown view. One-half natural size.

Fig. 6. *Camelops hesternus.* Portion of right mandible. Amer. Mus. 8620. A, crown view. B, lateral view. One-half natural size.

Although numerous proximal phalanges of camels are preserved in the American Museum and University of California collections from Fossil Lake, none of them resembles the phalanx from Washtuckna Lake, Washington, described by Hay (1921, p. 600–1) as the type of a new species, *Camelus maximus*. To this species Hay referred some limb elements from Fossil Lake, largely on the basis of size. There seems to be no valid reason for excluding those limb elements from *Camelops hesternus*.

?Tanupolama sp.

The specimen here referred to *Tanupolama* is a portion of the left maxillary, A. M. N. H. 8624. It was described as *Auchenia vitakeriana* by Cope in 1878. Later Cope became convinced that it possessed only one superior premolar rather than two, necessitating its inclusion in the genus *Holomeniscus*. Wortman (1898) concluded that there were two premolars and included the form in the genus *Camelops*.

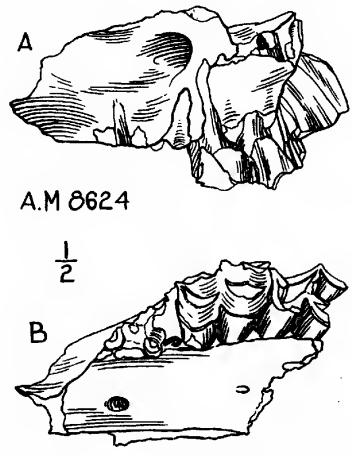

Fig. 7. *?Tanupolama* sp. Left maxilla. Amer. Mus. 8624. A, lateral view. B, crown view. One-half natural size.

The specimen consists of the major portion of a left maxillary bone containing M^1 and part of M^2. The fourth upper premolar is represented by three strong roots, one postero-internal and two external. The position of the roots suggests that P^4 was a triangular tooth with an antero-posterior diameter about two-thirds that of M^1. The possibility that the tooth belonged to the milk dentition was considered, but excavation of the jaw revealed no permanent tooth in position to replace it. A

small; irregular pit in front of the antero-external root of P^4 indicates that the animal may have possessed a vestigial P^3. A larger pit in front of the internal root of P^4 has no significance with regard to the teeth; similar pits are found in modern camels.

The three genera of fossil camels with which this specimen might claim kinship are *Eschatius*, *Camelops* and *Tanupolama*. It is excluded from *Eschatius* because P^4 is much better developed than in that genus. Compared with *Camelops hesternus* from Rancho La Brea, the Fossil Lake form shows a distinct similarity in the shape of M^1. The fourth premolars cannot be compared accurately, since the roots alone are left. P^3, if present, was very greatly reduced compared with *C. hesternus*. The position of the infraorbital foramen above the boundary between P^4 and M^1 is similar to that in *Camelops*, but its shape, with the lateral border inclined downward and forward instead of downward and backward, is more like that in the recent *Lama* and in *Tanupolama*. The general size of the Fossil Lake specimen is smaller than that of *Camelops*.

The discovery of well preserved skull and skeletal material of a medium-sized camel at McKittrick prompted Stock[1] to erect a new genus, *Tanupolama*. There is a startling similarity between the specimen here under consideration and the figured specimens of *Tanupolama stevensi*. No significant differences in the maxillary bone or dentition are to be found. The Fossil Lake specimen agrees very closely in size with the known specimens of *Tanupolama*. It is, therefore, tentatively referred to that genus. With the present fragmentary material, it is futile to attempt a specific determination.

Eschatius sp.

Eschatius conidens was described by Cope (1884*b*, pp. 19–20), using as the type a maxillary bone containing all its teeth, preserved in the Museum of the School of Mines of Mexico and coming originally from Tequixquiac. At the same time Cope described some remains from Fossil Lake, consisting of a fragmentary left maxillary lacking all the teeth and with the lateral wall of the alveoli missing, a fragment of the mandible containing P_4 and isolated pieces of the skull, which he referred to the same genus and species.

The character which separates the genus *Eschatius* from the other genera of Pleistocene camels is the reduction of P^4 to a simple cone. In the Fossil Lake specimen all that remains of P^4 is one alveolus, that

[1]Stock, Chester. 1928. 'Tanupolama, a New Genus of Llama from the Pleistocene of California.' Carnegie Instn. of Wash., Publ. 393, pp. 31–38.

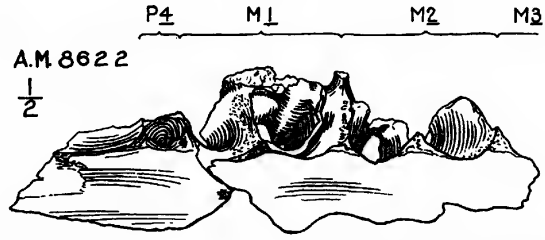

Fig. 8. *Eschatius* sp. Left maxilla. Amer. Mus. 8622. Crown view. One-half natural size.

for the postero-internal root. The maxillary border is preserved anterior to this alveolus, precluding the possibility that any antero-external root was present. There is no way of ascertaining whether there was a postero-external root. The reduction of P^4 seems, therefore, to be indicated clearly enough to warrant the inclusion of the specimen in the genus *Eschatius;* but it would be presumptuous to attempt to establish its specific identity with the Mexican form.

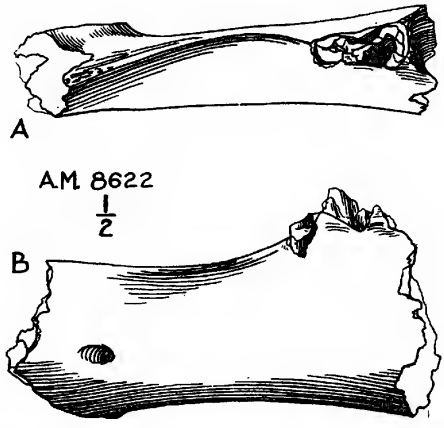

Fig. 9. *Eschatius* sp. Left mandible. Amer. Mus. 8622. A, crown view. B, lateral view. One-half natural size.

A mandibular fragment, A. M. N. H. 8622, the anterior part of the left ramus, including P_4 and half the symphysis, was also referred by Cope to *E. conidens.* Its chief characteristics are the absence of P_1 and the antero-posterior elongation of P_4, which has two well developed roots.

At the same time that he described *E. conidens,* Cope also erected another species of *Eschatius, E. longirostris,* the type and only known

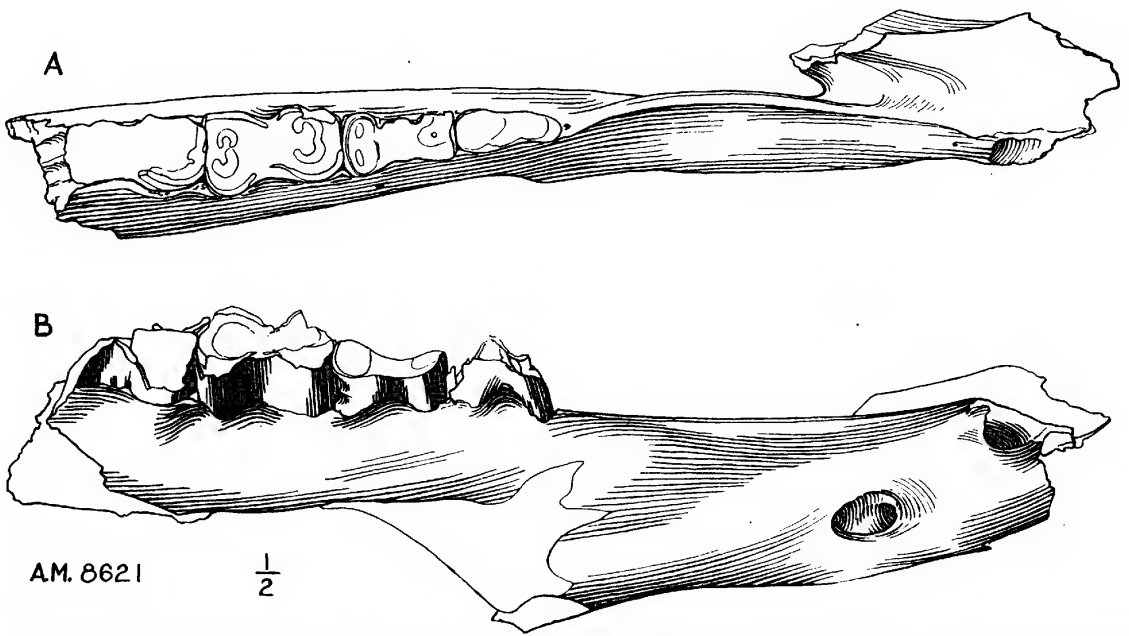

Fig. 10. *Eschatius* sp. Right mandible. Amer. Mus. 8621. A, crown view. B, lateral view. One-half natural size.

specimen (A. M. N. H. 8621) being the right ramus of a mandible containing exceedingly deeply worn P_4, M_1 and $_2$ and part of M_3. It differs from the mandible described above by having a longer diastema; this is, however, correlated with a generally larger size and might be due to advanced age. The symphysis of this mandible is co-ossified, while that of the specimen referred to *E. conidens* by Cope is not. Comparison of the size of the teeth with that of the upper teeth, indicated by the alveoli, in the maxillary considered above, leads to the conclusion that the mandible constituting the type of *E. longirostris* belongs to the same species as the other *Eschatius* material of Fossil Lake. The fragmentary mandible originally referred to *E. conidens* by Cope very likely appertained to a smaller or younger individual.

The limb elements of *E. conidens* are not clearly separable from those of *Camelops hesternus*, differing chiefly in being slightly smaller.

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